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Paramphistomosis in Small Ruminants: An Epidemiological Evaluation in Goats and Sheep

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Abstract

A serious parasite disease that affects tiny ruminant species all over the globe is called paramphistomosis, and it is brought on by many kinds of the species Paramphistomum. Employing data from Indian abattoirs and fields, the prevalence of paramphistomosis in goats and sheep has been researched. A paramphistomosis test performed at the abattoir indicated that 31.9% of goats and 37.2% of sheep responded positively. For goats, the worm levels were 24.2M ± 3.6SD, whereas for sheep, they were 26.2M ± 4.6SD. Following a coprological study, paramphistomosis was discovered in 19.7% of goats and 24.3% of sheep. For goats and sheep, respectively, the egg numbers were 8.5M±3.8SD and 9.3M±5.3SD. The frequency of paramphistomosis seems to be significantly influenced by the time of year. In contrast to the summer and winter periods, a greater proportion of livestock screened positive during the rainy and post-rainy times. Seasonal differences in the populations of adult flukes and eggs were statistically significant ($p<0.01$). The rates of goats and sheep by gender and age that were found were not statistically significant. The study comes to the conclusion that pasture-grazing goats and sheep are particularly vulnerable to paramphistomosis in the late summer. Therefore, it is highly advised that an effective anthelmintic be administered in from March to June and from October to November to prevent infection and minimize long-term financial losses to local animal owners.

Keywords: Paramphistomosis, goats, sheep, seasons, gender and age, livestock, egg and worm levels

INTRODUCTION

Assessing the epidemiology of goats and sheep is crucial to maintaining the health and productivity of these animals. Understanding and controlling the numerous variables affecting the health of sheep and goats depends on epidemiology, which studies the occurrence and causes of illnesses in communities (1). A systematic approach to gathering and assessing information about the number of animals and health conditions of goats and sheep is epidemiological evaluation. The prevalence of certain illnesses, the incidence of diseases, and the determination of factors impacting the spread of diseases (2). One of the most important aspects of epidemiologic assessment in sheep & goats is the calculation of illness prevalence. This entails figuring out how common certain diseases are and where they are found in a community. Using targeted therapy techniques requires an understanding of the incidence of diseases such as reproductive abnormalities, gastrointestinal parasites, and respiratory infections (3). An additional crucial step in the epidemiological evaluation procedure for small ruminants is the identification and assessment of risk variables. These elements may consist of innate tendencies, environmental influences, and management techniques. For example, poor food, overcrowding, and unhygienic conditions can all facilitate the dissemination of infectious illnesses among sheep and goats (4). An analysis of sheep and goat epidemiology considers the impact of management choices on disease dynamics. The risk of disease transmission can be impacted

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by intensive farming practices, animal transportation, and close contact with wildlife. The long-term health of sheep and goat populations must be preserved, and these dangers must be reduced through the use of organic and bioresponsible farming practices (5).

Study (6) evaluated the “specificity (Sp)” of an "enzyme-linked immunosorbent assay (ELISA)" It uses the special multiprotein complex P22 to detect particular antibodies against the “Mycobacterium tuberculosis complex (MTC)” in cattle, pigs, sheep, and goats-the four domestic animal species that are most important to the MTC and serve as hosts. The study (7) examined the national monitoring information gathered by the “National Animal Diseases Referral Expert System (NADRES)”&its control method to evaluate the epidemiology of "peste des petits ruminants (PPR)" in terms of time and space. Research (8) investigated the frequency of A. ovis infections in goats and ticks, the locations of these infections, and any potential associations with anemia along with additional health indicators. Furthermore, A. ovis's genetic diversity was assessed. Study (9) examined the geographic distribution, the impact on the economy, the genes linked to the virulence of the virus, genetic epidemiology, and related topics, including improved diagnostic methods, immunoprophylaxis, antiviral medications, and potential future developments in the treatment of infectious diseases.Research (10) investigated the particular epidemiological risk factors associated with PPR in Odisha.

Study (11) evaluated the incidence of intestinal parasite infections in goats in the Egyptian Giza Governorate.Study (12) examined the prevalence of bacterial and viral enteropathogens in diarrheal sheep and goats in Medina, Saudi Arabia. Research (13) investigated the prevalence of the disease in sheep & goats within a semi-arid area of northeastern Brazil and evaluated the possible contribution of rearing procedures as a risk factor for the spread of the infection.Research (14) evaluated the economic effects and epidemiological characteristics of “lumpy skin disease (LSD)," “Sheep pox (SP)," and “Goat pox (GP)” in northeast Nigerian farmers.Study (15) evaluated the risk factors and seroprevalence in sheep & goats from Pakistan's “Khyber Pakhtunkhwa (KP)” area.

Study (16) implemented CART data mining modeling to determine CCPP seroprevalence and risk variables in governorates with the highest numbers of sheep and goats. Research (17) evaluated the global molecular prevalence of Enterocytozoon bieneusi infections in sheep and goats, with a particular emphasis on the genotypes of this parasite. Research (18) investigated the characteristics, prevalence, and regional distribution of heat-producing virus infections in sheep & goats in Spain, the EU's largest group of native, smaller ruminants. Study (19) examined “Goat Pox (GP)” outbreaks to understand the disease's epidemiology & assess the financial impact on farmers. That was achieved by employing participatory disease follow-ups with participatory rural evaluation approaches. Study (20) assessed the prevalence of “Cystic Echinococcosis (CE)” in small ruminants on specified farms, concentrating on the disease's virology, epidemiology, molecular, and clinical features. The measurement of IgG antibody was used as a reference point for CE illness & was assessed in combination with relevant risk factors.

The goal of this study was to examine the epidemiological features and risk factors linked via paramphistomosis in goats & sheep in Gujarat.

METHODS

An area to study

The study was conducted over the duration of one year, from March 2021 to February 2022, in Gujarat's plain irrigated region, which is situated in western India. The region enjoys a subtropical humid environment and is located around 333 meters above sea level. Gujarat's seasons are displayed in Figure (1).

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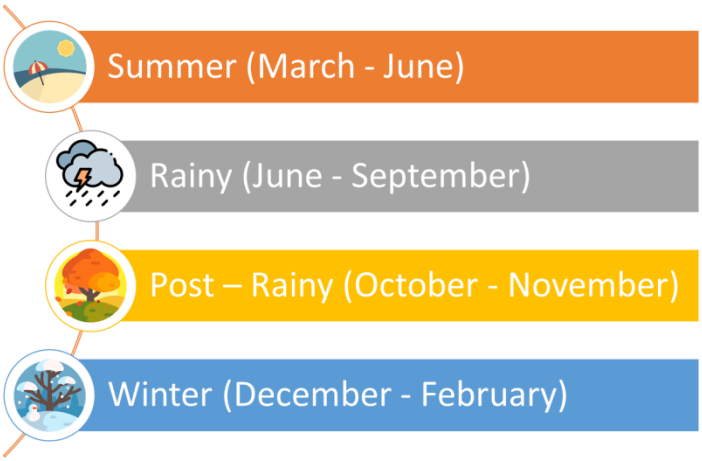

Figure (1). Seasons with month for Gujarat

(Source: Author)

An examination of coprological

The research area's sheep (n = 400, ranging from 26 to 44 animals each month) & goats (n = 365, ranging from 22 to 48 animals per month) had their feces examined. Samples were taken in airtight bottles with 8% formalin and labeled with the month of collection, the animal's name, its sex, and its dental age.Both qualitative and quantitative analyses were used to evaluate the samples.

Study of the abattoir

The reticulum and rumen of 210 slaughtered sheep (with a monthly range of 14–18 animals) and 215 goats (with a monthly range of 12–21 animals) were investigated in Surat, Gujarat. Fine forceps were used to collect the paramphistomosis from each rumen and reticulum. They are labeled with the month of gathering and placed into plastic beakers filled with 0.8% saline solution. The animal's name, its gender, and its dental age. The collected paramphistomosis were counted and protected in 73% alcohol.To prepare permanent mounts and identify them taxonomically based on their morphological characteristics, a few of these were flattened, fixed in 12% formalin, and dyed with borax carmine.

Weather information

The data pertaining to mean monthly temperature, rainfall, and relative humidity for Gujarat shows 1037 millimeters of rainfall between March 2021 and February 2022 in Gujarat. The range of the mean relative humidity was 41.2% in May to 54.3% in August. The average yearly temperature was 13◦C at the least and 34◦C at the maximum, respectively, in January and June.

Statistical evaluation

The data on paramphistomosis prevalences in slaughterhouses and coprological settings were compared using the Chi-square test. ANOVA was utilized to compare mean egg number & worm level in sheep and goats utilizing SPSS 16.0 for Windows. To compute the number of eggs, divide the entire amount of fluke count by the total amount of species that was looked into. It was determined that a p-value below 0.01 was statistically significant.

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RESULT

Abattoir examination

The prevalence and worm counts of paramphistomosis in sheep, as reported by abattoirs, are presented in Table (1).The prevalence and worm counts of paramphistomosis in goats according to abattoirs are shown in Table (2).Compared to goats (25.1%), sheep (27.1%) were more widespread. Compared to other seasons, Compared to other seasons, the post-rainy season displayed a significantly ($p<0.01$) greater prevalence (27.1% in goats and 25.1% in sheep).

Table (1). The prevalence and worm counts of paramphistomosis in sheep (Source: Author)

Seasons		**Summer**	**Rainy**	**Winter**	**Post-Rainy**
Sheep	No.of examined	55	50	49	56
	Infected (%)	26.6%	24.6%	23.7%	27.1%
	Mean	30.2	26.2	23.5	31.3
	SD	6.8	4.6	3.2	7.2

Table (2). The prevalence and worm counts of paramphistomosis in goats (Source: Author)

Seasons		**Summer**	**Rainy**	**Winter**	**Post-Rainy**
Goat	No.of examined	56	52	50	57
	Infected (%)	24.6%	23.6%	21.7%	25.1%
	Mean	28.2	24.2	21.5	30.3
	SD	5.8	3.6	2.2	6.2

In sheep, the mean ± standard deviation of the worm level was 26.2 ± 4.6 (ranging from 0 to 203), whereas in goats, it was 24.2 ± 3.6 (ranging from 0 to 178).Seasonally, Sheep and goat worm levels were significantly ($p<0.01$) increased compared to past seasons in the post-rainy season.

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Coprological examination

The coprological prevalence & egg number (M ± SD) for sheep are shown in Table (3). For goats, Table (4) shows egg number (M ± SD) and the coprological prevalence. Compared to goats (19.7%), sheep showed a higher prevalence level (24.3%).

Table (3). The prevalence and worm counts of paramphistomosis in sheep (Source: Author)

Seasons		**Summer**	**Rainy**	**Winter**	**Post-Rainy**
Sheep	No.of examined	100	105	103	92
	Infected (%)	12.8%	24.3%	22.3%	10.3%
	Mean	5.3	9.3	7.4	3.2
	SD	2.5	5.3	3.2	1.7

Table (4). The prevalence and worm counts of paramphistomosis in goats (Source: Author)

Seasons		**Summer**	**Rainy**	**Winter**	**Post-Rainy**
Goat	No.of examined	82	119	73	91
	Infected (%)	11.3%	19.7%	18.5%	9.7%
	Mean	5.1	8.5	7.2	2.5
	SD	2.3	3.8	4.9	2.1

The highest occurrence was discovered during the rainy season, and the lowest during the winter. There was statistical significance ($p<0.01$) in the observations. Whereas the egg number (M ± SD) in goat was 8.5± 3.8 (with a range 0-85), it was 9.3± 5.3 (with a range 0-70) in sheep. For sheep, the number of eggs above 15 eggs per gram was noted in the months of September and October, and for goats, in the month of September. When compared to summer and winter, the egg number of sheep and goats was significantly ($p<0.01$) higher during the rainy season. The majority of the time, the infection rate was determined to be between moderate and severe. Between sheep and goats, there were no appreciable variations in the amount of eggs or worms. Due to the random sample collection

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from the sheep and goat and the lack of worm level correlation, nothing was made to correlate the egg quantity with the worm level.

The age and gender-specific prevalence of paramphistomosis in sheep is described in Table (5).Table (6) presents the paramphistomosis prevalence in goats by gender and age.

Table (5). Prevalence of paramphistomosis in sheep (Source: Author)

coprological examination		**Age**			**Gender**	
		Less than one year	Between one – three years	More than three years	Male	Female
Sheep	No.of examined	160	103	137	160	240
	Infected (%)	17.5%	15.3%	17.4%	16.5%	18.3%
Goat	No.of examined	159	92	114	170	195
	Infected (%)	15.7%	9.1%	14.3%	14.5%	15.7%

Table (6). Prevalence of paramphistomosis in goat(Source: Author)

abattoir examination		**Age**			**Gender**	
		Less than one year	Between one – three years	More than three years	Male	Female
Sheep	No.of examined	86	57	67	111	99
	Infected (%)	41.1%	35.6%	29.3%	34.3	38.7%
Goat	No.of examined	78	64	73	90	125
	Infected (%)	36.4%	29.8%	30.7%	29.5%	35.7%

Animals under the age of one year showed a greater prevalence in abattoir examinations than those between the ages of one and three, as seen in Figure (2). The infection rate in females was higher than in males.

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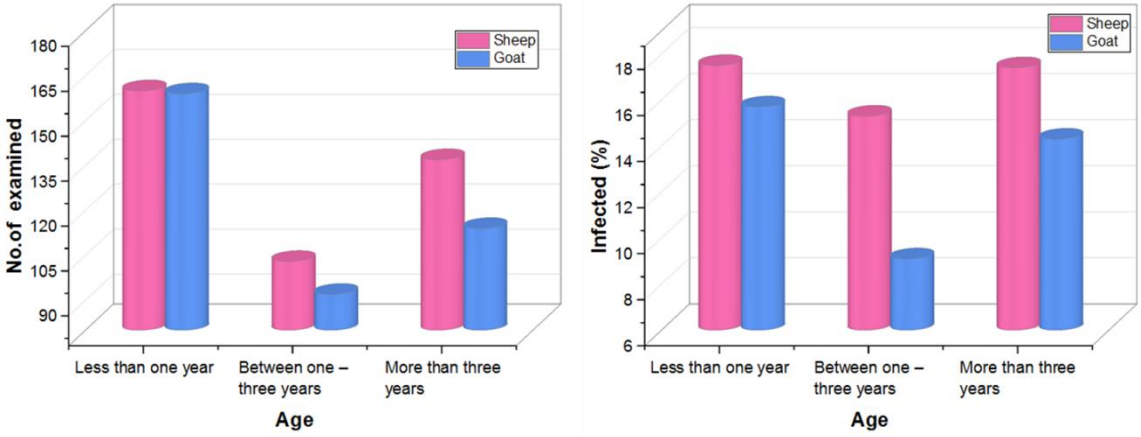

Figure (2). Comparison of animals under the ages in abattoir examination

(Source: Author)

Figure (3) illustrates that in coprological exams, animals younger than one-year-old demonstrated a higher prevalence than those older than one to three years old. Infection rates were higher in females than in males.

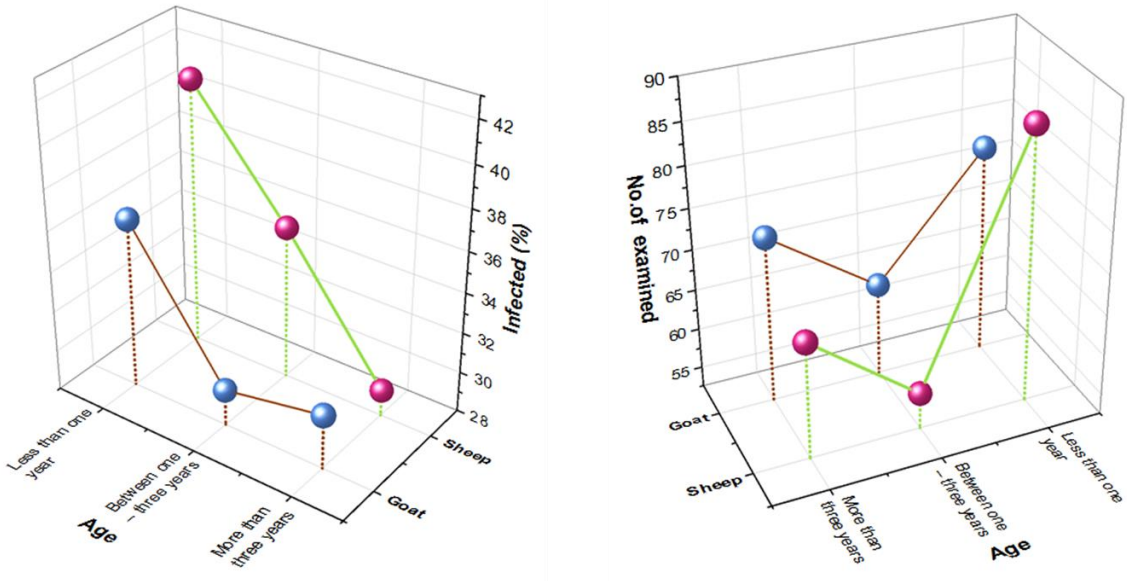

Figure (3). Comparison of animals under the ages in Coprological examination

(Source: Author)

CONCLUSION

The epidemiological evaluation of sheep and goat paramphistomosis highlights the significance of focused preventative actions, such as better husbandry techniques and planned deworming, for efficient management in the area.The study finds that data from Indian fields and abattoirs have been used to investigate paramphistomosis, a major parasitic disease that affects small ruminant species worldwide. According to the research, paramphistomosis

is fairly widespread in sheep and goats; tests conducted using abattoir-based samples revealed that 37.2% of sheep and 31.9% of goats tested positive. The levels of worms in sheep were 26.2M ± 4.6SD, but in goats, they were 24.2M ± 3.6SD. Studies using coprological methods further verified the existence of paramphistomosis, demonstrating positive results in 19.7% of goats & 24.3% of sheep. For goats, the egg numbers were 8.5M ± 3.8SD, while for sheep, they were 9.3M ± 5.3SD. The study shows that the prevalence of paramphistomosis is significantly affected by the seasons, with a higher percentage of positive screenings in the post-rainy and rainy seasons than in the summer and winter. However, there were no statistically significant variations in the rates of paramphistomosis between goats and sheep based on gender or age. It is highly advised to give an effective anthelmintic in late summer (June) or early post-rainy season (October) to minimize infection, maintain the best development and yield of sheep and goats, and reduce the ongoing financial losses to local animal owners.

REFERENCES

[1] Loi, F., Laddomada, A., Coccollone, A., Marrocu, E., Piseddu, T., Masala, G.,& Rolesu, S. (2019). Socio-economic factors as indicators for various animal diseases in Sardinia. PLoS One, 14(6), e0217367. Doi: 10.1371/journal.pone.0217367

[2] Krasteva, S., Jara, M., Frias-De-Diego, A., & Machado, G. (2020). Nairobi sheep disease virus: a historical and epidemiological perspective. Frontiers in Veterinary Science, 7, 419. Doi: 10.3389/fvets.2020.00419/full

[3] Coffin-Schmitt, J. L., Moore, E. V., McKune, S. L., Mo, R., Nkamwesiga, J., Isingoma, E., ... & Mariner, J. C. (2021). Measurement and sampling error in mixed-methods research for the control of Peste des Petits Ruminants in the Karamoja subregion of Northeastern Uganda: A cautionary tale. Preventive Veterinary Medicine, 196, 105464. Doi: 10.1016/j.prevetmed.2021.105464

[4] Bhardwaj, V., Dhungyel, O. P., de Silva, K., Dhand, N. K., & Whittington, R. J. (2022). The role of foot conformation in susceptibility of Merino sheep to footrot. Small Ruminant Research, 217, 106850. Doi: 10.1016/j.smallrumres.2022.106850

[5] Clemmons, E. A., Alfson, K. J., & Dutton III, J. W. (2021). Transboundary animal diseases, an overview of 17 diseases with potential for global spread and serious consequences. Animals, 11(7), 2039. Doi: 10.3390/ani11072039

[6] Infantes-Lorenzo, J. A., Moreno, I., Roy, A., Risalde, M. A., Balseiro, A., de Juan, L. ...& Domínguez, M. (2019). Specificity of serological test for detection of tuberculosis in cattle, goats, sheep, and pigs under different epidemiological situations. BMC veterinary research, 15(1), 1-8. Doi: 10.1186/s12917-019-1814-z

[7] Balamurugan, V., Vinod Kumar, K., Dheeraj, R., Kurli, R., Suresh, K. P., Govindaraj, G. ...& Roy, P. (2021). Temporal and spatial epidemiological analysis of Peste des petits ruminant's outbreaks from the past 25 years in sheep and goats and its control in India. Viruses, 13(3), 480. Doi: 10.3390/v13030480

[8] Cabezas-Cruz, A., Gallois, M., Fontugne, M., Allain, E., Denoual, M., Moutailler, S. ...& Chartier, C. (2019). Epidemiology and genetic diversity of Anaplasma ovis in goats in Corsica, France. Parasites & Vectors, 12, 1-11. Doi: 10.1186/s13071-018-3269-7

[9] Karki, M., Venkatesan, G., Kumar, A., Kumar, S., & Bora, D. P. (2019). Contagious ecthyma of sheep and goats: A comprehensive review on epidemiology, immunity, diagnostics and control measures. Veterinarski arhiv, 89(3), 393-423. Doi: 10.24099/vet.arhiv.0208

[10] Rath, P. K., Panda, S. K., Mishra, B. P., Karna, D. K., Sahoo, G., Mishra, U. K., & Patra, R. C. (2020). Epidemiological risk factor analysis in goats and sheep naturally infected with Peste des petits ruminants virus. J. Entomol. Zool. Stud, 8(3), 546-549.

[11] Hassan, N. M., Farag, T. K., Abu El Ezz, N. M., & Abou-Zeina, H. A. (2019). Prevalence assessment of gastrointestinal parasitic infections among goats in Giza Governorate, Egypt. Bulletin of the National Research Centre, 43(1), 1-7. Doi: 10.1186/s42269-019-0151-5

[12] Shabana, I. I., Bouqellah, N. A., & Zaraket, H. (2017). Investigation of viral and bacterial enteropathogens of diarrheic sheep and goats in Medina, Saudi Arabia. Trop. Biomed, 34(4), 944-955.

[13] de Macedo, L. O., Santos, M. A. B., da Silva, N. M. M., do Rêgo Barros, G. M. M., Alves, L. C., Giannelli, A., ... & de Carvalho, G. A. (2019). Morphological and epidemiological data on Eimeria species infecting small ruminants in Brazil. Small Ruminant Research, 171, 37-41. Doi: 10.1016/j.smallrumres.2018.12.006

[14] Limon, G., Gamawa, A. A., Ahmed, A. I., Lyons, N. A., & Beard, P. M. (2020). Epidemiological characteristics and economic impact of lumpy skin disease, sheeppox, and goatpox among subsistence farmers in northeast Nigeria. Frontiers in veterinary science, 7, 8. Doi: 10.3389/fvets.2020.00008

[15] Malik, A. I., Ijaz, M., Yaqub, T., Avais, M., Shabbir, M. Z., Aslam, H. B.,& Khan, A. (2018). Sero-epidemiology of bluetongue virus (BTV) infection in sheep and goats of Khyber Pakhtunkhwa province of Pakistan. Acta tropica, 182, 207-211. Doi: 10.1016/j.actatropica.2018.03.010

[16] Selim, A., Megahed, A., Kandeel, S., Alanazi, A. D., & Almohammed, H. I. (2021). Determination of Seroprevalence of contagious caprine pleuropneumonia and associated risk factors in goats and sheep using classification and regression tree. Animals, 11(4), 1165. Doi: 10.3390/ani11041165

[17] Taghipour, A., Bahadory, S., & Javanmard, E. (2021). The global molecular epidemiology of microsporidia infection in sheep and goats with focus on Enterocytozoon bieneusi: a systematic review and meta-analysis. Tropical medicine and health, 49(1), 1-12. Doi: 10.1186/s41182-021-00355-7

[18] Caballero-Gómez, J., García-Bocanegra, I., Jiménez-Martín, D., Cano-Terriza, D., Risalde, M. A., López-López, P.,& Rivero-Juarez, A. (2022). Epidemiological survey and risk factors associated with hepatitis E virus in small ruminants in southern Spain. Zoonoses and Public Health, 69(4), 387-393. Doi: 10.1111/zph.12935

[19] Bolajoko, M. B., Adedeji, A. J., Dashe, G. D., Òsemeke, O. H., & Luka, P. D. (2019). Molecular epidemiology and economic impact of goat pox on small holder sheep and goats farmers in north central Nigeria. Small Ruminant Research, 179, 75-78. Doi: 10.1016/j.smallrumres.2019.09.013

[20] Bala, J. A., Balakrishnan, K. N., Abdullah, A. A., Yi, L. C., Bitrus, A. A., Abba, Y., ... & Mohd-Lila, M. A. (2018). Sero-epidemiology of contagious ecthyma based on detection of IgG antibody in selected sheep and goats farms in Malaysia. Adv. Anim. Vet. Sci, 6(5), 219-226. Doi: 10.17582/journal.aavs/2018/6.5.219.226